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CHEMICAL TECHNOLOGY.

Chemical Technology; or Chemistry in its Applications to Arts and Manufactures. Edited by C. E. Groves, F.R.S., and W. Thorp, B.Sc. Vol. I., "Fuel and its Applications." By E. J. Mills, D.Sc., F.R.S., and F. J. Rowan, C.E. (London: Churchill, 1889.)

THIS work is described as substantially a new edition of the well-known "Chemical Technology" of Richardson and Watts, which in its turn was founded on the German work of Knapp. In its new form, however, it bears about as much resemblance to its prototype as the famous horse of Wallenstein does to the original animal—"The head, neck, legs, and part of the body have been repaired; all the rest is the real horse." How much of the real Knapp is left in the work takes some time and trouble to discover. We recognize here and there a woodcut—not always in the best state of preservation—but the descriptions appended even to these particular cuts are in most cases entirely recast, if not wholly rewritten. As the present work is to all intents and purposes an original production, it would have been better to have so described it. It may be that a sort of good-will has grown up around Richardson and Watts's "Technology" which the publishers desire to retain; but the connection between the two works is so slight that they are practically independent.

The present volume deals exclusively with fuel and its applications. The term fuel is employed in its widest possible sense, and its applications are treated of no less generally. The special employment of fuel in chemical manufactures is reserved for future treatment in the volumes which are concerned more particularly with these subjects. The most superficial comparison of this work with that upon which it is assumed to be founded will serve to show how enormous has been the advance in knowledge of the principles upon which the proper consumption of fuel depends. Take, for example, the question of smoke-prevention. In the preface to the 1856 edition it was stated that a method of smoke-prevention, although much wanted, had not then been discovered. The present work shows that we have changed all that. The idea of "consuming smoke" is obsolete. The conditions of complete combustion are to-day so well understood that it is only the indifference of manufacturers or the apathy of the authorities which prevents the greater part of industrial firing with solid fuel from being practically smokeless. Even if this were not so, gaseous fuel, the use of which is largely extending, is absolutely smokeless. This kind of fuel might be applied to many industries which have not yet adopted it, and without in any way hampering them, and would indeed be so applied if the authorities could be brought to regard it as coming within the definition of "the best practicable means" (to quote the words of the Act) for preventing smoke. We do not, of course, intend by this to insist on the exclusive adoption of gaseous fuel, although the time may come when, partly on economic and partly on sanitary grounds, such adoption may, as the late Sir C. W. Siemens predicted would be the case, become compulsory. How much the community might save, both in health and pocket, by the more systematic adoption of smoke-preventing arrangements, has been demonstrated over and over again, and we may well hope that the various exhibitions of appliances which seek to realize a consummation so devoutly to be wished may bring about this result in a not too distant future. The public may rest assured that efficient smoke-preventing appliances do exist, as the work before us abundantly demonstrates, and it ought to be the duty of the various centres of local government to insist on the more general adoption of these appliances. What can be done by a benevolent despotism in such a matter was well shown by the action of Lord Palmerston in the case of the metropolis, and there is nothing to prevent even such towns as Glasgow, Sheffield, Birmingham, and Newcastle from having atmospheres at least as sootless as that of London.

The out-put of coal in this country up to 1883 practically followed the law of Jevons as modified by Marshall. In that year it attained a maximum of nearly 164 million tons, or about four times the amount raised in 1850. In 1884 the quantity raised was 161 million tons, and in the following year it fell to about 159 millions. This diminution is due to various causes, partly natural and partly economic and social. It is, however, safe to say that a more intelligent appreciation of the principles which determine the conversion of the store of energy existing in coal into actual work has more than compensated for the smaller out-put. The world to-day gets more duty from its coal than it did even six years ago. Authorities differ slightly as to the manner in which the coal raised is distributed. According to Peckar, whose estimate seems to be preferred by the authors, it is somewhat as follows:—[1]

Destination.	Per cent.
Iron manufacture	32·40
Factories	21·87
Dwelling-houses	16·36
Gas- and water-works	6·46
Mining	6·38
Steamers	6·46
Railways	1·76
Copper-works	0·72
Sundries	0·64
Export	10·54

Although it is no necessary part of a treatise which is mainly concerned with the applications of fuel, the authors devote some considerable space to what may be termed the chemistry of coal-getting, *e.g.* the occurrence and nature of fire-damp, the relations of atmospheric temperature and pressure to its escape, fire-damp indicators, the influence of coal-dust on explosions, &c. On the whole, the information given is sound and accurate, and brought fairly well up to date. And the authors steer a very even and judicious course among points on which much difference of opinion still exists. We think, however, that the very careful and remarkable analyses of certain North Country explosions by the Messrs. Atkinson are worthy of more notice than they have apparently received, as they seem to be absolutely conclusive on the point that explosions can be originated and propagated by coal-dust alone.

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[1] No explanation is given of the fact that these numbers add up to 103·59.

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The question of the spontaneous ignition of coal scarcely meets with the treatment which its importance merits, and no reference is made to the work of the Royal Commission appointed in 1875 at the instigation of the Board of Trade and the Committee of Lloyd's to inquire into this subject. Many hundreds of vessels have without doubt been lost by the spontaneous ignition of coal cargoes, and there is a general belief that, with the considerable increase of temperature in steam-ships due to the introduction of high-pressure boilers and triple-expansion engines, the liability to spontaneous firing in the coal-bunkers is greatly augmented. The old idea of Berzelius, that the tendency to spontaneous ignition was mainly due to the presence of readily-oxidizable pyrites is now exploded. The experiments of Richters, Durand, and, in quite recent times, of Prof. Vivian Lewes, have shown that this substance has quite a subordinate effect. The cause is rather to be ascribed to the effect of absorbed or occluded oxygen upon finely-divided carbonaceous matter, *e.g.* dust or fine slack. The authors are also of this opinion, and state that the only method of preventing fire from such a cause is to keep the temperature of the mass of coal as low as possible by means of thorough ventilation by currents of air. In a paper recently read before the Institution of Naval Architects, in which this question is discussed, Prof. Lewes comes to the conclusion that this so-called ventilation is undoubtedly one of the most prolific causes of spontaneous ignition, and he instances the cases of the four colliers, *Euxine*, *Oliver Cromwell*, *Calcutta*, and *Corah*, which were loaded at Newcastle under the same tips, at the same time, with the same coal, from the same seam. The first three were bound for Aden, and were all ventilated. The *Corah* was bound for Bombay, and was not ventilated. The three thoroughly ventilated ships were totally lost from spontaneous ignition of their cargo, whilst the *Corah* reached Bombay in safety. Prof. Lewes points out that for ventilation to do any good, cool air would have to sweep continuously and freely through every part of the cargo, a condition impossible to attain, whilst anything short of that only increases the danger, the ordinary methods of ventilation supplying about the right amount of air to create the maximum amount of heating. A steam coal absorbs twice its bulk of oxygen, and takes about ten days to do it under favourable conditions, and it is this oxygen which in the next phase of the action enters into chemical combination and causes the serious heating.

One very remarkable change which is slowly making its way in this country is seen in the more extensive adoption of coal-washing machinery. Coal-washing machines have long been in use in Germany, France, and Belgium, and the exigencies of our iron manufacture are gradually necessitating their introduction in Great Britain, although the process has not yet reached the same degree of perfection as on the Continent. The effect of washing is to free the coal from pyrites and other mineral impurities. Of course it is only under special conditions that it can pay to subject the coal of this country to this process, but there is no doubt that as soon as the price of coal touches a certain point many coals which are practically unsaleable at present will be so treated. The authors describe a number of the more important coal-washing machines, and give details of their duty and cost.

The question of coking and coke-ovens naturally comes in for a very considerable share of attention, and practically all the more important methods are described and fairly well illustrated, and the general nature of the tars yielded by the various kinds of ovens is set forth, mainly on the authority of Mr. Watson Smith. One of the most valuable features in the work is the account given of the methods of using liquid fuel, and of the results obtained on various railways (principally Russian) and with various types of marine and stationary engines. The principles of domestic heating by solid and gaseous fuel, and relative efficiency of the various forms of open and closed grates and of gas stoves, are carefully stated, and considerable space is given to an examination of the modes of warming public buildings.

Analyses of boiler performances, and of the results obtained by mechanical stokers and by the application of gas-firing to boilers, methods of evaporation, with special reference to multiple effect apparatus, occupy a large portion of the section devoted to fuel in its applications to vaporization and evaporation; and the concluding portions of the book are occupied by descriptions of special forms of kilns and furnaces.

The work is admirably printed, and on the whole well illustrated, and, what is very important in a book which is mainly a work of reference, it is furnished with an excellent index.

T. E. Thorpe.

THE SELKIRK RANGE.

Among the Selkirk Glaciers; being the Account of a Rough Survey in the Rocky Mountain Regions of British Columbia. By William Spotswood Green, M.A., F.R.G.S. (London: Macmillan and Co., 1890.)

THE Canadian Pacific Railway, after crossing the watershed of the Rocky Mountains by the Hector Pass, descends for some four thousand feet into the valley of the Columbia River. This, for a hundred and seventy miles, flows in a northerly direction, parallel with the crest of the range. Then, after a great sweep to the west, it flows southward, parallel to its former course, till it receives the Kootenay, the head waters of which rise only a mile and a half away from its own. The mountain-tract insulated by these rivers is called the Selkirk Mountains. It lies roughly parallel with the Rockies, and yet further west are the Gold Range and the Cascades. Thus the railway traverses a mountain region until the valley of the Frazer River, by which it finally emerges, begins to broaden out towards the sea. It is, to use Mr. Green's words, "a region of vast ravines and wide valleys, whose sides, when not bare rock precipices, are clad in sombre forests, through which wild mountain torrents rush from glacier sources to placid lakes, where, after resting for a while and reflecting the hoary cedars and hemlocks, they issue forth as great rivers, and with swift current hurry on to lose themselves in the Pacific."

Though the peaks of the Selkirks look down upon the railway, their recesses, before Mr. Green's visit, were still almost unknown. The reason is not difficult to discover. The forests which clothe their lower slopes are unusually

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